INSTRUCTIONS

DIESEL-ENGINE DESCRIPTION AND SPECIFICATIONS

GE 7FDL DIESEL ENGINES

COMPONENT LOCATION TERMS (See Fig. 1)

The following terms will be used throughout this book in locating various components on the engine. Their designation or explanation is as follows:

FREE END – The end of the engine where the turbocharger and intercoolers are mounted.

GENERATOR END – The end of the engine where the generator (or alternator) is mounted.

RIGHT AND LEFT SIDE – The right side or left side of the engine is determined by viewing the engine while facing the generator end.

CYLINDER LOCATION – The cylinders are numbered from the free end to the generator end. No. 1 Right and No. 1 Left cylinders are nearest the turbocharger on all engines. Fig. 1 shows a schematic overhead view of a twelve-cylinder engine. All eight-cylinder and sixteen-cylinder locomotive engines are arranged in the same manner except for the quantity of cylinders.

CRANKSHAFT ROTATION – During engine operation, the crankshaft rotates clockwise when viewed from the free end; counterclockwise when viewed from the generator end.

FIG. 1, E-13141A

ENGINE SPECIFICATIONS

Specifications for the 7FDL8, 7FDL12, and 7FDL16 engines are given in Table I.

ENGINE DESCRIPTION

General Electric has developed the FDL engine for use in diesel-electric railroad locomotives. Its design and rating is based on extensive laboratory tests backed up by thousands of hours of field experience with many engines.

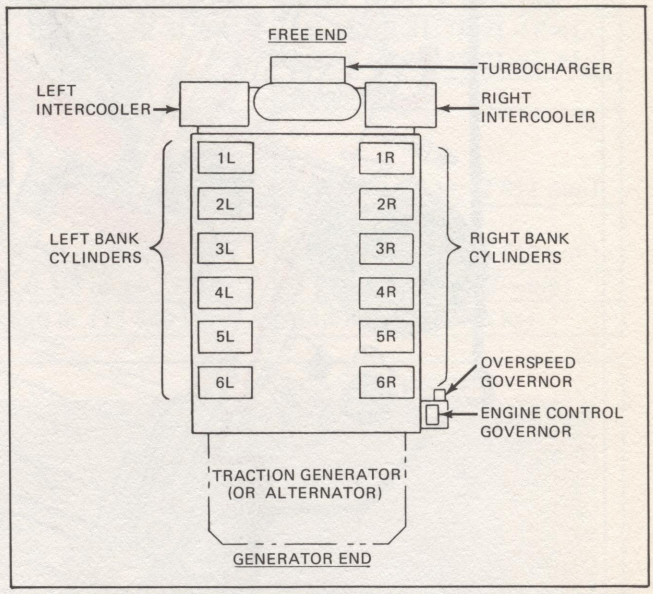

FIG. 1. SCHEMATIC OVERHEAD VIEW OF ENGINE (12-CYLINDER ENGINE SHOWN).

A typical cross-section view of the engine is shown in Fig. 2. External views of the engine are shown in Figs. 3 and 4.

The following brief description merely highlights the principal features of the engine. Each component is more fully described in its respective section of the instruction book.

MAIN FRAME

The engine main frame, of special iron, is cast in one piece including reinforcing ribs and gussets. Further strength and rigidity are added to the frame by bolting the main bearing caps horizontally as well as vertically. Four machined surfaces are used for mounting the main frame on the locomotive platform. The crankcase inspection covers are lightweight, with a quick-acting single-handle release.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

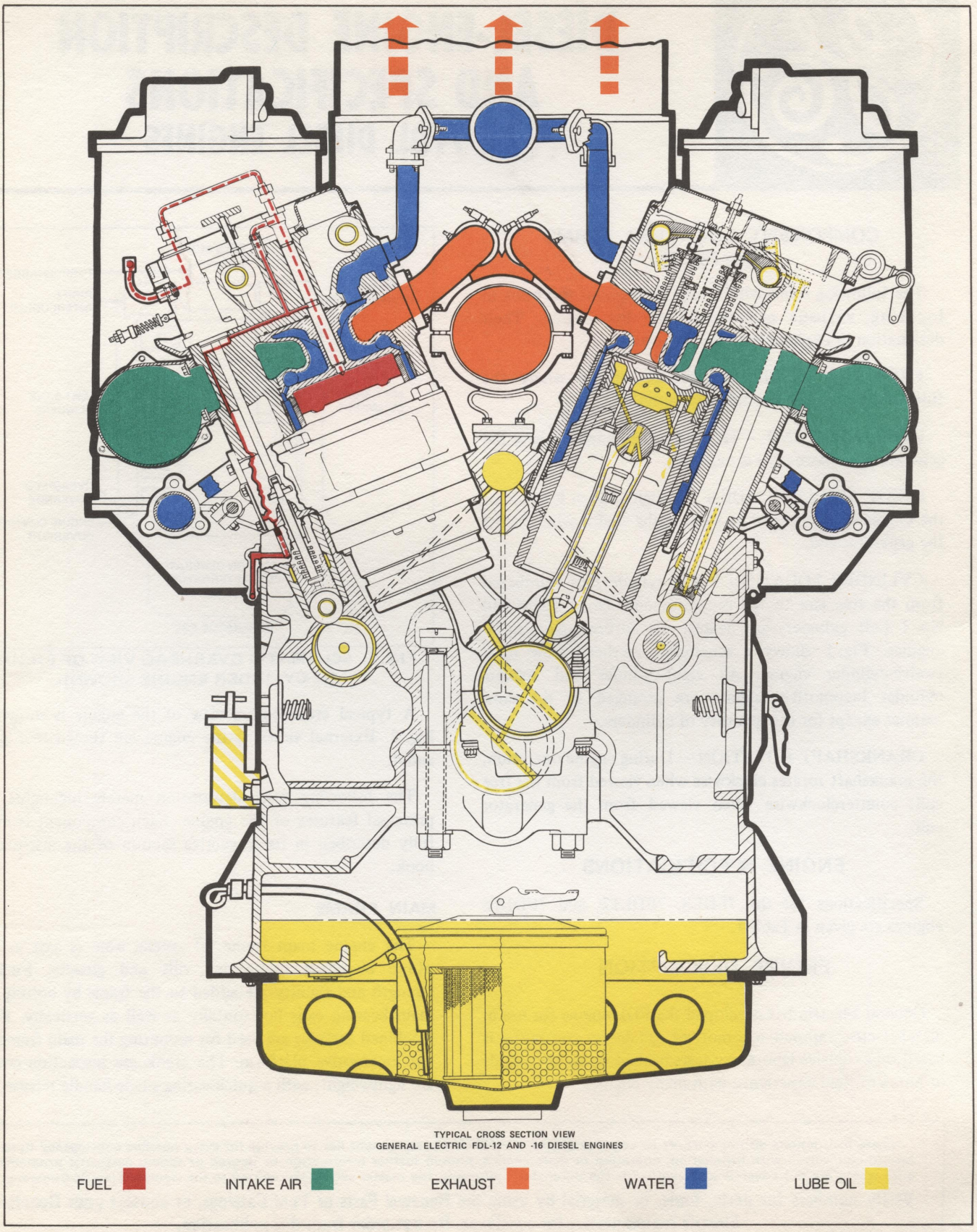

FIG. 2, E-16188B

FIG. 2. TYPICAL CROSS-SECTION VIEW OF GENERAL ELECTRIC FDL DIESEL ENGINE.

TABLE I, ENGINE SPECIFICATIONS

	7FDL8	7FDL12	7FDL16
Number of Cylinders	8	12	16
Stroke Cycle	4	4	4
Cylinder Arrangement	45-degree V	45-degree V	45-degree V
Bore	9 in. (228,6 mm)	9 in. (228,6 mm)	9 in. (228,6 mm)
Stroke	10-1/2 in. (266,7 mm)	10-1/2 in. (266,7 mm)	10-1/2 in. (266,7 mm)
Compression Ratio	12.7-1	12.7-1	12.7-1
Idle Speed	400, 425, or 450 rpm	400, 425, or 450 rpm	400, 425, or 450 rpm
Full-Rated Speed	1000, 1025, or 1050 rpm	1000, 1025, or 1050 rpm	1000, 1025, or 1050 rpm
Firing Order	1R-1L-2R-2L-4R-4L-3R-3L	1R-1L-5R-5L-3R-3L-6R-6L-2R-2L-4R-4L	1R-1L-3R-3L-7R-7L-4R-4L-8R-8L-6R-6L-2R-2L-5R-5L
Turbocharger	Single	Single	Single
Engine Dimensions:			
Height (over-all, including stack)	7 ft. 9-5/8 in. (2 378 mm)	7 ft. 9-5/8 in. (2 378 mm)	9 ft. 2-11/16 in. (2 811 mm)
Length (over-all, including generator)	15 ft. 1-1/2 in. (4 610 mm)	17 ft. 10 in. (5 436 mm)	21 ft. 8-7/16 in. (6 615 mm)
Width (over-all)	5 ft. 8 3/8 in. (1 737 mm)	5 ft. 8-3/8 in. (1 737 mm)	5 ft. 8-3/8 in. (1 737 mm)
Weight (dry, engine only)	27,785 lb. (12 603 kg)	34,940 lb. (15 849 kg)	43,510 lb. (19 736 kg)

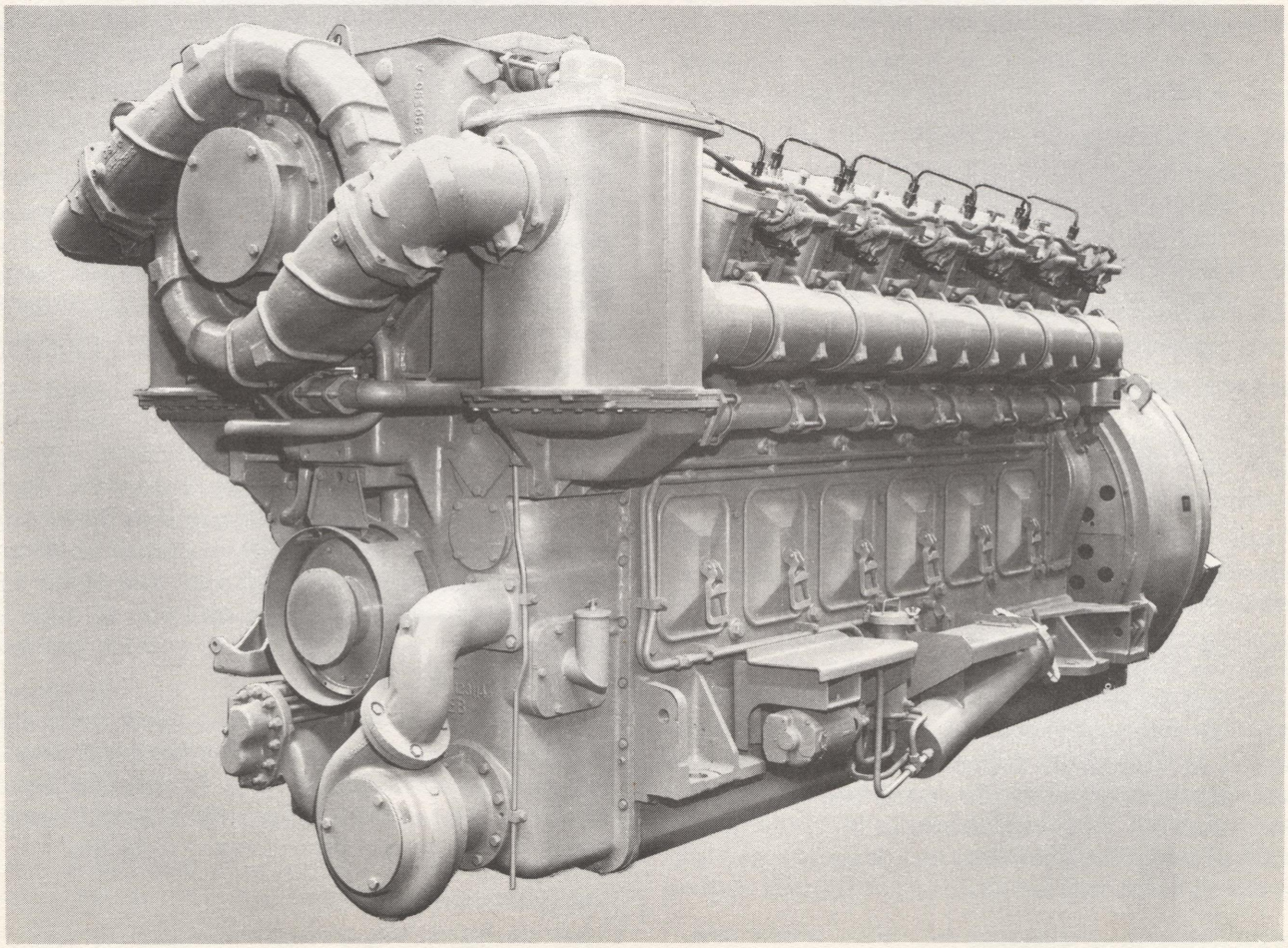

FIG. 3, E-22293

FIG. 3. OBLIQUE VIEW OF 12-CYLINDER ENGINE — FORWARD (FREE) END.

CRANKSHAFT

The crankshaft is forged of high-quality steel and hardened for long life. The journal surfaces are precision ground, and all bearing surfaces are force-fed with lubricating oil. A removable, split drive gear, mounted on the generator end of the shaft, directly drives the camshafts and, through additional gears, the control and overspeed governors. A pump drive gear, mounted on the free end of the crankshaft, is torsionally isolated from the crankshaft and, through an idler gear, drives the lube-oil pump and the water pump.

The traction-generator armature shaft is directly bolted to the crankshaft flange.

BEARINGS

Replaceable, precision-fit main- and connecting-rod bearings are used. They have steel backs and are lined with specially formulated bearing materials. The "high crush" connecting rod bearing used on new engines has been modified to improve load-carrying capacity and service life.

The crankshaft thrust bearings are located at the No. 4, 6, and 8 main bearing in the eight-, twelve-, and sixteen-cylinder engine, respectively.

The camshafts rotate in replaceable, split-sleeve aluminum bearings.

VIBRATION DAMPERS

A sealed, viscous-type damper mounted on the free end of the crankshaft is used in the twelve- and sixteen-cylinder engines. The eight-cylinder engine uses two round, sealed dampers bolted together.

The function of the vibration damper is to dampen and control crankshaft torsional vibration.

BALANCE SHAFTS

On the eight-cylinder engine only, two eccentric shafts of forged, alloy steel are used to counterbalance secondary vibrations set up in the engine.

These shafts are mounted in the bottom of the main frame on each side of the engine, and are driven from the crankshaft through a gear train.

CAMSHAFTS

Two sectional camshafts of forged, alloy steel are used to operate the engine valves and fuel pumps. These shafts are mounted in the frame on each side of the engine, and are directly gear-driven from the crankshaft at one-half crankshaft speed. Each sectional camshaft is made up of individual precision machined sections which are connected together with stud bolts and nuts.

CONNECTING-ROD ASSEMBLY

Each connecting-rod assembly consists of a master connecting rod and an articulated connecting rod. These rods are made of forged steel. The articulated rod is bolted to a pin fitted in the master connecting rod. The master connecting rod is fastened around the crankshaft by a bolted-on cap. This design provides for a maximum of bearing surface area.

PISTONS

Current-production engines use two-piece pistons. The steel crown, contoured on the top to form the combustion chamber and on the bottom to form cooling-oil passages, is bolted to an aluminum-alloy skirt.

Pistons used in older engines were one-piece, cast-iron pistons with six, and later four, rings. Current-production engines also use four rings – three compression rings and one oil-control ring.

The rings may be inspected, or new rings installed, by removing the cylinder without disconnecting the piston. The pistons are lubricated and cooled by oil forced through holes drilled in the connecting rods to the piston pins and into the cavity under the piston crown.

CYLINDER ASSEMBLIES

Cylinder-jacket castings are of a special cast iron, with the removable steel cylinder head held solidly against the top of the cylinder jacket by the cylinder liner. The alloy-steel intake and exhaust valve seats are an integral part of the cylinder head. The valves are arranged with the two intake valves outboard, and the exhaust valves toward the center of the engine "V". The fuel pump, injection nozzle, valve rocker arms and allied valve equipment are located within the upper portion of the cylinder casting. The cylinder assembly is fastened to the engine frame by bolts, through four heavy lugs located on the lower corners of the cylinder jacket.

CYLINDER LINERS

Renewable, water-cooled, centrifugal-cast-iron cylinder liners are provided. Liners on older engines were plated with chrome on their wear surfaces and used iron rings. Present-production engines use a special liquid-bath hardening process applied to the inner bore of the liner and use chrome-plated rings. The two types of liners are interchangeable, provided the proper rings are used with the specified liner. *

The upper end of the liner is seated against the cylinder head on two concentric gaskets. The lower end is sealed with the cylinder jacket by three O-rings. The liner is installed in the cylinder jacket with a close fit and is secured in place by eight bolts through a clamp ring.

FUEL-INJECTION PUMPS

An impulse, or "jerk" type, fuel-injection pump is mounted in the top of each cylinder and is operated by a

*Revisions are indicated by marginal bars.

pushrod from the camshaft. An adjustable tappet, located below the pump pushrod, provides accurate pump timing. The pump increases fuel pressure for injection, accurately measures the quantity to be injected, and delivers the fuel at the proper time to the cylinder through the fuel nozzle.

FUEL NOZZLES

An injection nozzle is mounted in the center of each cylinder and is connected to the fuel-injection pump by a short, high-pressure line. Fuel is forced through tiny holes in the nozzle tip which atomize the fuel into a very fine mist in a symmetrical pattern for proper combustion. The injection nozzles are comprised of several components, easily renewable when required.

ENGINE-CONTROL GOVERNOR

The engine is equipped with an electro-hydraulic, speed-regulating governor which contains a small, internally-mounted, load-controlling rheostat. The governor is mounted on the governor drive gear case at the generator end and is driven from the right camshaft gear. The governor maintains desired engine speeds at all loads, by regulating fuel rack travel of the injection pumps and generator excitation. The governor has its own oil supply and its own oil pump, which supplies the pressure needed to regulate the governor's operation.

TURBOCHARGER

A single turbocharger, mounted on top of the free-end cover, is driven by the engine exhaust gases. It provides air to the cylinders at approximately twice atmospheric pressure. The turbocharger is cooled and lubricated from the engine cooling-water and lubricating-oil systems.

INTERCOOLERS

The engine is equipped with two intercoolers, which are small enclosed radiators mounted on each side of the engine. They are connected between the turbocharger and each air intake manifold. Part of the cooling-system water flows through the intercooler tubes, and compressed air from the turbocharger blows through the core fins. The water absorbs heat from the air, so that air delivered to the cylinders is slightly above engine cooling-water temperature.

MANIFOLDS

The air-intake manifolds are mounted to the outside of each bank of cylinders. They are sectional in construction, for ease in alignment and quick engine maintenance.

The exhaust manifold is mounted in the "V" of the engine. Individual flanged sections, coming off the single main pipe or multiple main pipes, are bolted to each cylinder. The main sections are made of stainless steel with bellows to allow for thermal expansion. See Tab DE-11 for further details.

AIR SYSTEM

Incoming engine air, used to support combustion in the cylinders, passes through primary and then secondary air filters. The air discharged from the filters is directed to the turbocharger to supply filtered air to the engine.

FUEL SYSTEM

Fuel is pumped through the system by an externally-mounted electric-motor-driven, fuel booster pump. The pump transfers fuel from the locomotive fuel tank, through a strainer and filter, to each fuel injection pump. Excess fuel returns to the tank through a pressure-regulating valve. A relief valve is installed near the pump to protect the system against excessive pressure. A water-activated fuel heater is also available.

COOLING SYSTEM

Cooling water is circulated through the system by a single, engine-mounted water pump. The pump is mounted on the free-end cover and is gear-driven from the crankshaft through an idler gear. Cooling water is forced through the engine, turbocharger, oil cooler, and intercoolers, to carry engine heat away. The locomotive is equipped with radiators, where the water is cooled by air from the radiator fan.

LUBRICATING SYSTEM

Lubricating oil is circulated through the engine by a single, gear-driven, lube pump mounted on the free-end cover. A relief valve is installed to protect the pump against excessive pressure. An externally-mounted, water-cooled oil cooler is used in the system to remove heat which the oil picks up in cooling the pistons and other engine parts.

LUBRICATING-OIL FILTERS

An externally-mounted, filter is installed in the lubricating-oil system to filter out foreign matter from the oil. Current-production engines also have a suction strainer mounted in the engine oil pan.

SAFETY DEVICES

The engine is equipped with an overspeed governor which shuts the engine down if the engine speed exceeds a predetermined safe value. This governor is mounted on the governor-drive gear box located at the generator end and is driven from the right camshaft gear. On current-production engines it supplies oil under pressure to the overspeed-derater link, causing it to contract to a fixed length. In the event of an overspeed, the pressure oil is shut off, letting the link expand, turning off the fuel to the cylinders. A manual reset button is provided to reset the governor after the overspeed trip has been corrected.

Also located within the overspeed-derater link are three temperature-sensing pellets which expand at a predetermined temperature. The pellets react to engine intake manifold air temperature. In the event manifold

temperature rises above the predetermined value, the pellets expand, causing the device to expand gradually, reducing fuel to the cylinders.

On older engines, when the overspeed governor trips, it closes butterfly valves located in the air-intake manifolds. These shut off air to the engine, and the engine-control governor is signaled to shut off the fuel supply to the cylinders.

Two independent safety devices, one to detect low-engine lube-oil pressure and one to detect low water pressure, are built into the engine-control governor. These devices provide protection from either condition throughout the entire engine speed range. Should the lube oil or water pressure drop below the established safe value, the engine is automatically shut down. Manual reset buttons are provided to reset the devices after they have been actuated.

All current-production engines are further protected from overheating and overloading by having the engine-control governor monitor the engine intake air manifold pressure. When this pressure is below predetermined safe values, the governor will operate to electrically unload the engine and to mechanically limit the fuel until sufficient air is available for efficient combustion.

Two other optional types of governors are available and provide added protection to the engine. These are:

1. Modulating Governor – has no external low-oil-pressure and low-water-pressure reset buttons. This type governor automatically reduces engine load and speed temporarily when lower-than-standard lube-oil or water pressure exists. Governor will shut down engine when dangerously low pressures exist.

2. Altitude-Compensating Governor – has an additional pressure-sensing device that responds to low atmospheric air pressure to reduce the fuel and, thereby, achieve optimum combustion.

The engine is also equipped with a crankcase overpressure switch, mounted on the left-bank camshaft gear cover. This switch will trip when the pressure in the crankcase exceeds a predetermined safe value. When the switch is tripped, the engine is automatically shut down. A manual reset button is provided to reset the device.

CRANKING

On engines with d-c generators, the engine crankshaft is directly connected to the traction-generator armature. When the generator is electrically energized (from batteries) through its start field, the generator acts as a motor to rotate the crankshaft to start the engine. On those engines equipped with a-c generators (alternators), the two auxiliary generators are used as starting motors. After starting the engine, they are electrically reconnected as generators.

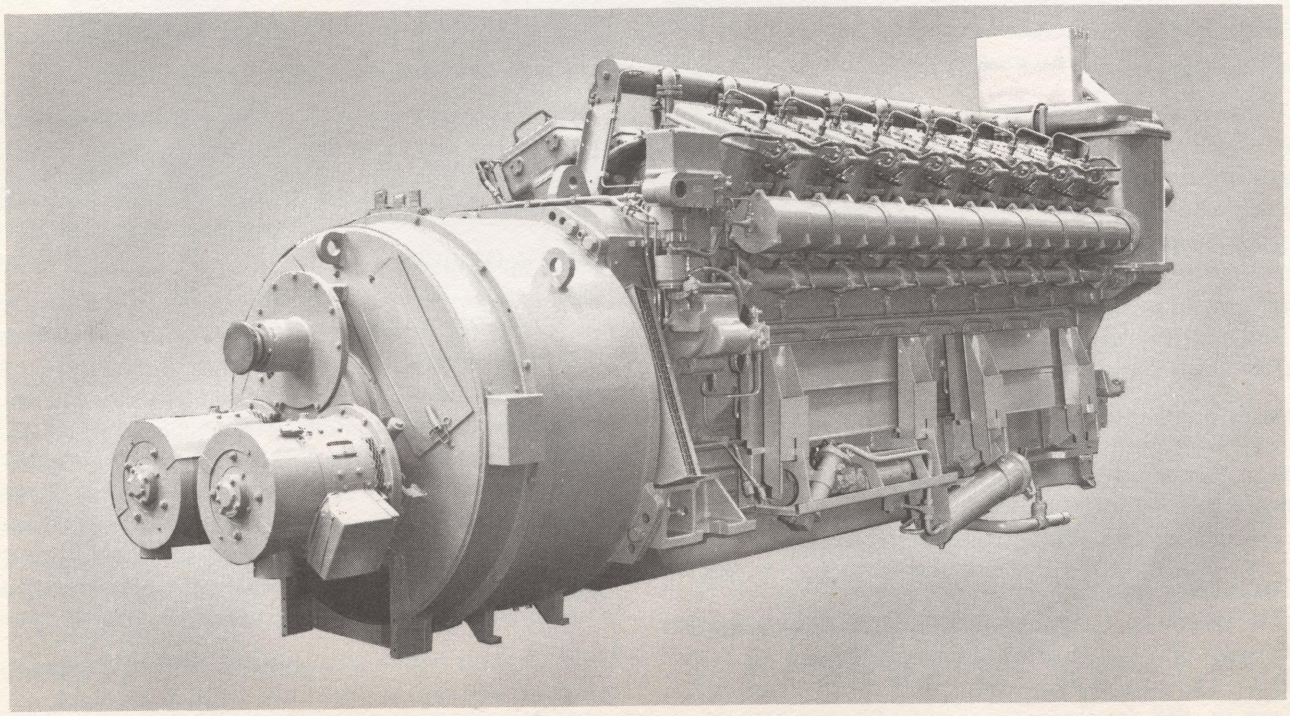

FIG. 4, E-22294

FIG. 4. OBLIQUE VIEW OF 16-CYLINDER ENGINE – GENERATOR (ALTERNATOR) END.

FIG. 5, E-22295

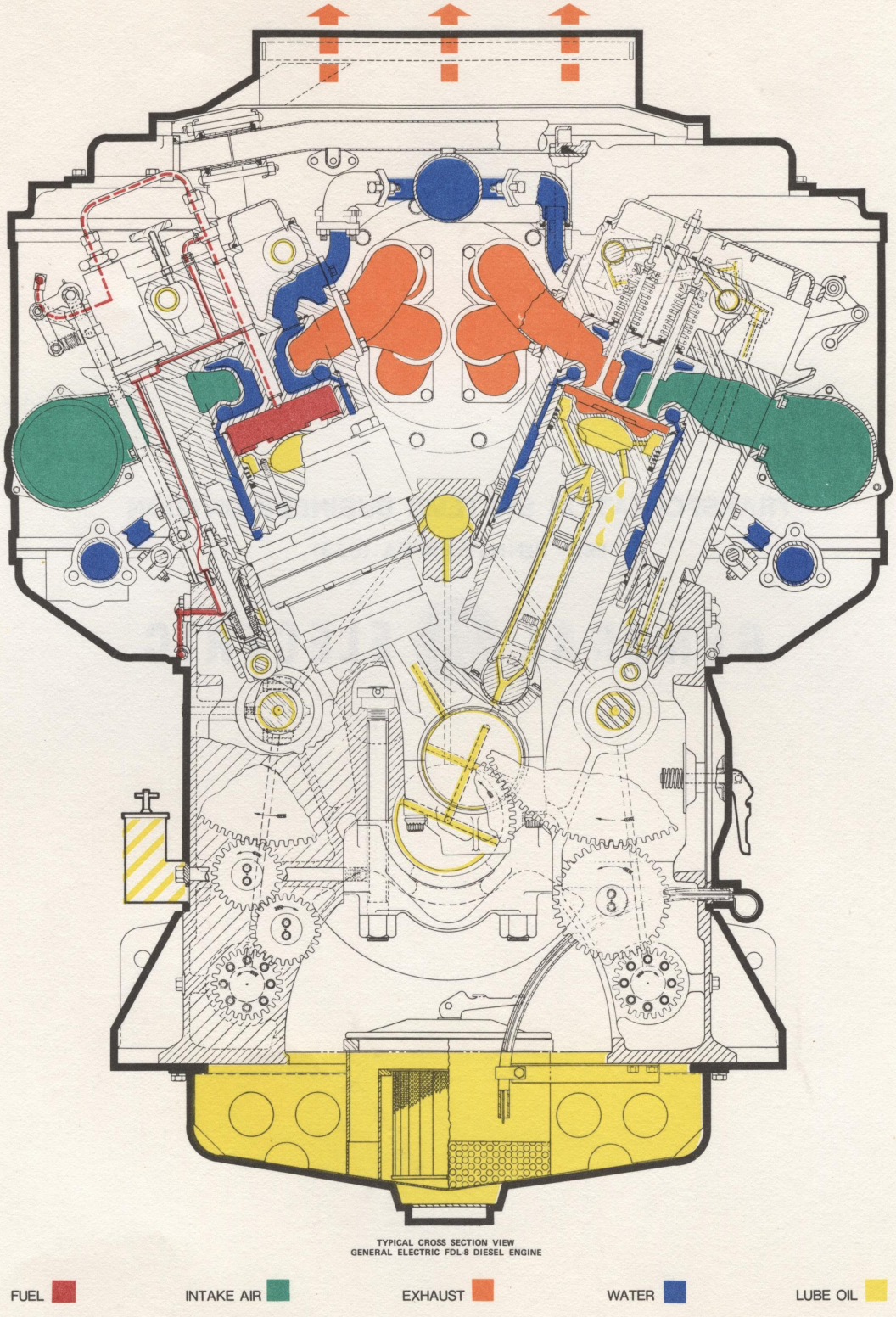

FIG. 5. CROSS-SECTION VIEW OF 8-CYLINDER ENGINE, SHOWING GEAR ARRANGEMENT.